Dehiscence and fenestration in patients with Class I and Class II Division 1 malocclusion assessed with cone-beam computed tomography

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Introduction: The aim of this study was to compare the presence of alveolar defects (dehiscence and fenestration) in patients with Class I and Class II Division 1 malocclusions and different facial types. **Methods:** Seventy-nine Class I and 80 Class II patients with no previous orthodontic treatment were evaluated using cone-beam computed tomography. The sample included 4319 teeth. All teeth were analyzed by 2 examiners who evaluated sectional images in axial and cross-sectional views to check for the presence or absence of dehiscence and fenestration on the buccal and lingual surfaces. **Results:** Dehiscence was associated with 51.09% of all teeth, and fenestration with 36.51%. The Class I malocclusion patients had a greater prevalence of dehiscence: 35% higher than those with Class II Division 1 malocclusion (P <0.01). There was no statistically significant difference between the facial types. **Conclusions:** Alveolar defects are a common finding before orthodontic treatment, especially in Class I patients, but they are not related to the facial types. (Am J Orthod Dentofacial Orthop 2010;138:133.e1-133.e7)

Orthodontic movement is achieved by biologic events in bone remodeling (resorption and apposition) of the alveolar process, which supports the teeth with involvement of the roots.[1] Since bone resorption occurs in the direction of tooth movement, the reduced volume of the alveolar bone, sometimes with minimal thickness, sometimes even nonexistent, is a complicating factor for orthodontic treatment.[2]

Previous studies and case reports have shown that, as the roots are displaced and move away from the center of the alveolar bone, there is increased risk of creating or exacerbating alveolar defects[3,4] and producing consequent mucogingival changes, such as gingival recession.[5-7] The lack of the facial or lingual cortical plate, which resulted in exposing the cervical root surface and affecting the marginal bone, represents an alveolar defect called dehiscence. When there is still some bone in the cervical region, the defect is called fenestration.[8] The occurrence of dehiscence and fenestration during orthodontic treatment depends on several factors, such as the direction of movement, the frequency and magnitude of orthodontic forces, and the volume and anatomic integrity of the periodontal supporting tissues.[1,4] To avoid these problems, the alveolar morphology must be determined before orthodontic treatment through imaging, which shows bone topography and anatomy. Currently, cone-beam computed tomography (CBCT) is the option chosen for most clinical dental situations, including the alveolar process, when a cross-sectional examination is indicated, because of its lower dose of radiation,[9,10] better image resolution,[11] and lower costs compared with multislice computed tomography.

To date, no study has been undertaken to compare the presence of alveolar defects in subjects with various malocclusions. The hypothesis we tested was that there is no difference in bone covering between the various malocclusions. Our aim was to compare the presence of dehiscence and fenestration between patients with

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The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.
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Submitted, December 2009; revised and accepted, February 2010.
0889-5406/$36.00

doi:10.1016/j.ajodo.2010.02.021

Table I. Distribution of malocclusions and facial types

Facial type *Malocclusion*	*Brachyfacial*	*Mesofacial*	*Dolichofacial*	*Total*
Class I	32	29	18	79
Class II Division 1	27	30	23	80
Total	59	59	41	159

Class I and Class II Division 1 malocclusions and different facial types by using CBCT.

MATERIAL AND METHODS

This study was approved by the institutional review board of Medical School Charité, Berlin, Germany.

We used pretreatment CBCT examinations of orthodontic patients from the radiological files of the Mesantis private orthodontic clinic in Berlin, Germany. The sample was selected by 1 observer, trained in the use of sectional images, who did not participate in the study. The following inclusion criteria were considered: CBCT examinations of patients over 18, with no previous history of orthodontic treatment; and patient of both sexes with Class I or Class II Division 1 malocclusions, mild-to-moderate crowding, and different facial types. The Class I samples were confirmed by the bilateral Class I molar and canine relationships: ANB between 2° and 4°, and overjet between 1 and 4 mm. The criteria for selecting the Class II Division 1 subjects were bilateral Class II molar and canine relationships, ANB ≥4° and overjet >4 mm. The facial types were divided according to NS.GoGn proposed by Reidel,[12] with the mesofacial group measuring from 27° to 37°; the brachyfacial group, <27°; and the dolichofacial group, ≥37°. All cephalometric measures used in the study were obtained from the original CBCT images. The exclusion criteria included patients with missing teeth and agenesis, and images suggesting periodontal disease such as horizontal or vertical proximal bone loss, furcal involvement, and calculus. Partial and low-resolution images were also excluded from the evaluation, as well as 133 teeth with extensive restorations involving the cementoenamel junction.

A total of 79 Class I and 80 Class II Division 1 malocclusion patients matched the inclusion criteria, giving 4319 teeth to be evaluated. The power analysis determined that a sample size of 139 patients would be sufficient to detect a 5% difference between malocclusion groups. The distribution of the malocclusion and facial types of all subjects is shown in Table I. Tables II and III show the sample characteristics according to malocclusion and facial type.

Table II. Mean values (± standard deviations) for age, ANB, overjet, and NS.GoGn in patients with Class I and Class II Division 1 malocclusions

	Class I	*Class II Division 1*
Age (y)	27.09 (7.46)	26.48 (8.18)
ANB (°)	2.52 (1.96)	6.66 (1.96)
Overjet (mm)	2.61 (0.86)	5.72 (1.13)
NS.GoGn (°)	29.32 (6.48)	30.98 (6.63)

Table III. Mean values (± standard deviations) for NS.GoGn in the facial types

	Brachyfacial	*Mesofacial*	*Dolichofacial*
NS.GoGn(°)	23.41 (3.28)	31.07 (1.74)	38.77 (2.86)

The images were obtained by using i-CAT tomography (Imaging Sciences International, Hatfield, Pa), with 47.7 mA, 120 kV, 40-second exposure time, and isotropic voxel size of 0.25 × 0.25 × 0.25 mm. The imaging protocol was performed with a 6-in field of view to include the entire facial anatomy. The files were exported to 512 × 512 pixels matrix in DICOM 3 format and processed by using InVivoDental software (Anatomage, San Jose, Calif). The patient's head was oriented by locating the Frankfurt plane parallel to the horizontal plane and in centric occlusion.

Two calibrated examiners (an orthodontist K.E. and a dentist K.F.V.) visually examined all the sectional images in a dark room, using a 24.1-in LCD monitor with resolution of 1920 × 1200 pixels. Both observers evaluated the same tomographic views blindly without knowing either the malocclusion or the facial type, or each other's results. First, the mesiodistal and buccolingual axes of each tooth were placed perpendicular to the horizontal plane. The total length of the root was evaluated in axial and cross-sectional slices at the buccal and lingual surfaces. Images that showed no cortical bone surrounding the root in at least 3 consecutive views were registered as having an alveolar defect. This lack of bone was classified as dehiscence when the alveolar bone height was more than 2 mm from the cementoenamel junction, based on the value for normal alveolar height.[13] It was classified as fenestration when the defect did not involve the alveolar crest. The root length was divided into 3 equal parts, from the cementoenamel junction to apex, to locate the third of the root with the alveolar defect.

After 20 days, an observer repeated the analysis of 25% of the examinations, randomly selected, to verify the reproducibility of the method.